Pedobiologia, Bd. 17, S. 418—427 (1977)

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Decomposition of a moorland litter, in relation to *Marasmius androsaceus* and soil fauna

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With one figure

(Accepted: 30. 1. 1977)

1. Introduction

In the course of field studies on the decomposition of vegetation at the Moor House National Nature Reserve in northern England (Grid Ref. NY 765329) the fungus *Marasmius androsaceus* (L. ex FR.) FR. was observed on senescent and dead leaves or stems of some of the major plants of the Reserve, including *Calluna vulgaris*, *Juncus squarrosus* [LATTER and CRAGG 1967], *Nardus stricta*, *Eriophorum vaginatum* and *Rubus chamaemorus*. *M. androsaceus* has been commonly reported on *Calluna* [MACDONALD 1949; DENNIS 1964], and has also been recorded on other plants e.g., *Pinus* [DENNIS 1964], *Picea*, *Pteridium* [DENNIS, pers. comm.], *Scirpus* [DENNIS 1948], *Erica* spp. and several other genera [MACDONALD 1949].

Colonization of decomposing leaf litter by *M. androsaceus* causes irregular patches of bleached cells, sometimes bounded by the dark zone lines associated with this type of fungus. No other moorland fungus has been observed to cause bleaching at Moor House. Colonization of new substrates is assisted by thin black rhizomorphs produced by the fungus. *M. androsaceus* is often considered as a parasite on heather, e.g., by MACDONALD (1949) who also describes the morphology of the fungus and its widespread distribution in Scotland. It is a basidiomycete of the white-rot type (SOPKO 1966), though he recorded that the decomposition of lignin in beech wood pulp was weak. The activity of white-rot type basidiomycetes in wood has been described in many studies, and a few workers report their activity in litter or soil (HINTIKKA 1964, 1970; FRANKLAND 1975; MANGENOT and KIFFER 1972). HINTIKKA (1970) defined white-rot humus and reported that litter decomposed more quickly when colonized by various white-rot basidiomycetes, including *M. androsaceus*, and CHASTUKHIN and NIKOLAEVSKAYA (1953) reported bleaching and weight loss of oak leaves in culture, after inoculation with the fungus; FRANKLAND (1975) suggested that another white-rot fungus, *Mycena galopus*, was responsible for a large part of the decomposition of leaves on a woodland site and caused a rapid liberation of nitrogen.

Field observations made on the blanket bog at Moor House during the course of a long-term litter decomposition experiment (HEAL, LATTER and HOWSON 1977) and a feeding study of an enchytraeid worm (LATTER and HOWSON 1978), indicated possible associations between the rate of decomposition of litters, the occurrence of *M. androsaceus*, and the occurrence and feeding of fauna on litter. This paper gives some of these observations and describes tests on the decomposition of colonized Rubus chamaemorus litter as well as its use as food for the enchytraeid worm, *Cognettia sphagnetorum* (VEJD.), the dominant soil fauna species on the blanket bog sites.

2. Site

The Reserve and its vegetation are described in HEAL and SMITH (1977). The site used in this study was an area of blanket bog with *Calluna vulgaris*, *Eriophorum vaginatum*, *Sphagnum* spp. and a small component of *Rubus chamaemorus*.

3. Method

3.0. Prefatory note

The methods used are only summarized below, those used for the litter decomposition experiments are fully described by HEAL et al. (1977) and those for the enchytraeid feeding tests by LATTER and HOWSON (1978).

3.1. Occurrence of *M. androsaceus* and fauna on decomposing litters

These observations were made on samples of the long-term decomposition experiment. Weighed samples of recently dead shoots and stems of *C. vulgaris* and leaves of *E. vaginatum* were placed in the field in September 1966, and abscissing leaves of *R. chamaemorus* in September 1967. To facilitate retrieval, Eriophorum or Rubus leaves, or shoots of *Calluna* were each placed in terylene mesh bags but Calluna stems were tethered with a piece of terylene line. Retrieved samples were examined annually for dry weight loss and moisture content over a period of 7 years (HEAL et al. 1977). In addition, obvious features of the decomposing litter were recorded, including presence of *M. androsaceus* (rhizomorphs or bleached areas), presence of fauna, and signs of feeding by fauna. On Rubus and Eriophorum leaves, the presence of *Marasmius androsaceus* could be observed on individual leaves, but for Calluna samples, *M. androsaceus* was rated for each sample from absent (0) to several rhizomorphs with bleaching (3). Fauna were extracted from samples by hand and numbers expressed per gram dry weight.

3.2. Dry weight loss of bleached and unbleached R. chamaemorus litter

R. chamaemorus leaves were collected from the field, 8 months after leaf-fall and sorted into those with and without bleached areas. Samples consisted of 10 air-dried leaves in nylon hair-nets and 10 samples of each type were placed in the field on 18. June 1969 and retrieved after one year on 17. June 1970. The conversion factors for air dry to oven dry weights were 0.8678 and 0.8381 for bleached and unbleached leaves respectively.

3.3. Growth of *C. sphagnetorum* on colonized R. chamaemorus leaves

R. chamaemorus leaves were collected from the field 9 months after leaf-fall on 24. June 1970, and litter estimated to be 2—3 years old was collected at the same time. The younger litter was sorted into bleached and unbleached leaves. *C. sphagnetorum* were extracted from cores of the litter region on 16. June 1970 and feeding tests were set up for each of the three litter types on 26. June 1970, and incubated at 11 + 1 °C for 8 weeks. All litters were washed on a sieve before use in the feeding tests.

Analyses for carbon, nitrogen, soluble tannin and crude fibre, were carried out on sub-samples of the Rubus litters used for the enchytraeid feeding test, by the Chemical service at Merlewood Research Station using methods described in ALLEN et al. (1974).

4. Results

4.1. Occurrence of *M. androsaceus* and fauna on decomposing litter

During the course of decomposition of samples in the field, *M. androsaceus* occurred on each type of litter, with bleached areas becoming clearly visible on leaves of *Rubus* and *Eriophorum*, and occasionally on leaflets of Calluna shoots, also wood inside parts of some stems and shoots of *C. vulgaris*, became bleached, and softened. Among colonized Rubus litter, 24—67% of leaves showing bleaching had rhizomorphs present. *M. androsaceus* reached maximum colonization on Rubus and Eriophorum leaves by 1—2 years (Table 1) and by 2—3 years on Calluna stems and shoots.

The fauna counts on *Rubus chamaemorus* were higher than on the other litters, with the exception of the high counts of Enchytraeidae on *Eriophorum vaginatum*, but the expression of results on an oven dry weight basis, and the very low weight of the later Eriophorum samples may have heightened the counts on this litter type. With the exception of *E. vaginatum*, numbers of Collembola on the litters were similar to those of enchytraeids; but lower numbers of mites and diptera occurred on all litters. The numbers of diptera were higher and the numbers of other groups were similar to, or lower than, their average field densities (STANDEN 1973; COULSON and WHITTAKER 1977), no doubt some fauna would be lost from samples during retrieval, and some missed in the hand sorting.

Table 1. The occurrence of *Marasmius androsaceus* and fauna on decomposing litters

A.	Age of litter after field placing									
	0	3 mths	6 mths	9 mths	1 yr	1·5 yr	2 yr	2·5 yr	3 yr	4 yr
Rubus leaves	22. 9. 1967									
M. androsaceus	0.4 ± 0.2	1.7 ± 0.7	3.4 ± 0.9	5.6 ± 0.8	7.9 ± 0.9	8.4 ± 0.5	7.6 ± 0.8	8.1 ± 0.6	4.5 ± 1.2	5.0 ± 1.1
Enchytraeids	0	0	0	0.1 ± 0.1	2.2 ± 1.5	0.0	18.5 ± 5.9	0	7.8 ± 5.4	9.7 ± 4.6
Collembola	0	0	2.1 ± 1.1	1.5 ± 0.7	12.2 ± 2.6	17.8 ± 5.4	12.6 ± 2.4	27.3 ± 12.4	3.6 ± 1.0	1.0 ± 0.5
Mites	0	0	0.4 ± 0.2	5.8 ± 1.7	4.8 ± 0.9	4.6 ± 3.1	7.8 ± 2.9	2.7 ± 0.8	0.8 ± 0.4	1.2 ± 0.7
Diptera	0	0	0.2 ± 0.2	0.1 ± 0.1	1.6 ± 0.5	2.4 ± 0.8	2.7 ± 1.0	5.0 ± 1.6	0.5 ± 0.5	1.7 ± 0.7

B.	Age of litter after field placing							
	0	6 mths	1 yr	2 yr	3 yr	4 yr	5 yr	7 yr
Eriophorum leaves	22. 9. 1966							
M. androsaceus	—*)	8.5 ± 0.4	8.2 ± 0.9	1.8 ± 0.6	5.0 ± 1.6	1.2 ± 0.5	0.6 ± 0.2	—
Enchytraeids	—	0	7.7 ± 6.7	26.9 ± 6.9	39.9 ± 14.8	50.0 ± 12.5	25.8 ± 14.5	—
Collembola	—	0	1.9 ± 1.3	3.8 ± 2.0	3.5 ± 1.8	2.7 ± 2.7	0	—
Mites	—	0	0.9 ± 0.9	3.1 ± 2.3	1.3 ± 1.2	0	0	—
Diptera	—	0	4.9 ± 2.7	1.9 ± 1.3	1.2 ± 1.2	3.5 ± 3.5	0	—
Calluna shoots	4. 9. 1966							
M. androsaceus	—	0.7 ± 0.2	1.0 ± 0.3	1.5 ± 0.3	1.7 ± 0.4	0.6 ± 0.2	0.8 ± 0.1	0.2 ± 0.2
Enchytraeids	—	0	0.2 ± 0.2	0.4 ± 0.1	1.9 ± 0.7	2.1 ± 0.8	6.1 ± 3.8	0.9 ± 0.7
Collembola	—	0	0.7 ± 0.1	4.7 ± 2.4	1.9 ± 0.4	1.6 ± 0.9	0.5 ± 0.2	0.2 ± 0.2
Mites	—	0	1.4 ± 0.3	1.0 ± 0.4	1.2 ± 0.6	0.7 ± 0.2	2.9 ± 1.4	0.2 ± 0.1
Diptera	—	0	0	0.3 ± 0.2	0	0	0.4 ± 0.3	0
Calluna stems	27. 8. 1966							
M. androsaceus	—	0.3 ± 0.2	0.6 ± 0.2	0.7 ± 0.2	0.5 ± 0.3	0.4 ± 0.2	1.0 ± 0.3	—
Enchytraeids	—	0	0.6 ± 0.3	0.04 ± 0.03	1.0 ± 0.4	1.9 ± 0.5	0.8 ± 0.2	0.4 ± 0.3
Collembola	—	0	0.1 ± 0.1	1.9 ± 1.2	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.1	0
Mites	—	0	0	0.04 ± 0.03	0.1 ± 0.1	0	0.3 ± 0.2	0
Diptera	—	0	0.3 ± 0.3	0	0	0	0	0

Note. *) not determined (—). Results for *M. androsaceus* on Rubus and Eriophorum leaves are numbers of leaves colonized per sample, and on Calluna, ranked estimates of colonization (0 to 4). Litter fauna results are numbers g^{-1} dry weight. Values are means of ten samples for each date, ± SE.

Table 2. Occurrence of fauna in relation to presence or absence of *M. androsaceus* on decomposing litters

	Rubus leaves		Eriophorum leaves		Calluna shoots		Calluna stems	
	%	n	%	n	%	n	%	n
Enchytraeids								
+	*47*	15	*63*	27	*50*	32	*38*	26
—	*80*	5	*85*	13	*44*	18	*63*	24
Collembola								
+	*61*	23	*24*	21	*53*	32	*19*	26
—	*43*	7	*22*	9	*39*	18	*29*	24
Mites								
+	*39*	23	*20*	15	*53*	32	*6*	16
—	*14*	7	*0*	5	*44*	18	*21*	14
Diptera								
+	*26*	23	*10*	21	*24*	17	*17*	6
—	*14*	7	*22*	9	*0*	3	*0*	4

The percentage (%) of samples (n) with fauna is given, over periods when the fauna type was present, for sample sets which showed both presence (+) and absence (—) of *M. androsaceus.*

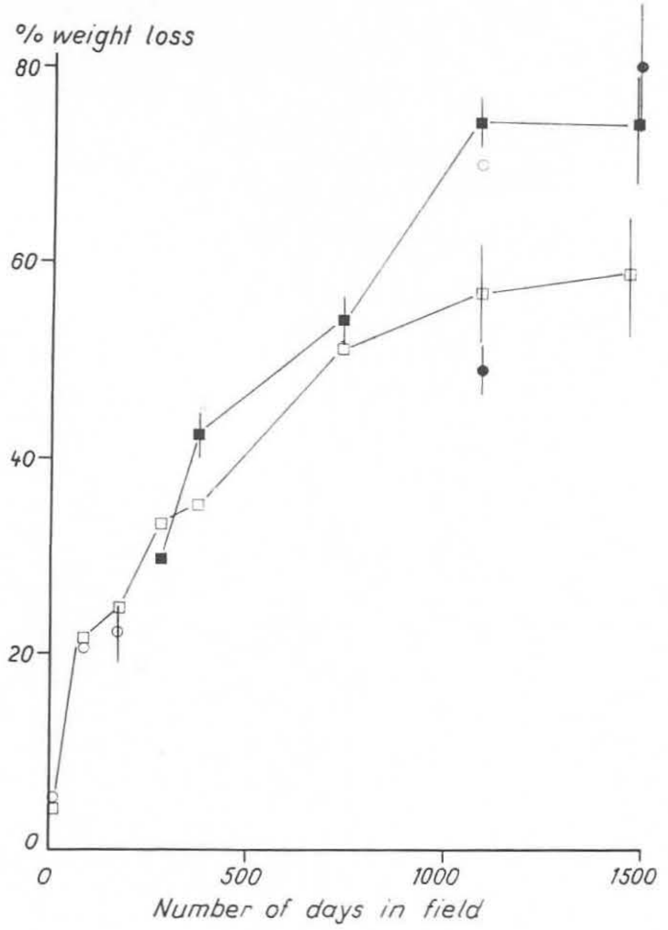

Fig. 1. Mean % dry weight loss of Rubus leaf litters for samples with presence and absence of *M. androsaceus* and enchytraeid worms, during a long-term litter decomposition experiment. Standard errors of > 1.5 are indicated by vertical bars. ■ □, *M. androsaceus* present, ● ○, *M. androsaceus* absent. Solid symbols enchytraeids present, open symbols enchytraeids absent.

On all the litters the fauna reached peak numbers after the peak of *M. androsaceus*, at around 2 years on Rubus and Eriophorum leaves and between 2—5 years on Calluna shoots and stems (Table 1). The occurrence of fauna on litters with *M. androsaceus* present or absent (Table 2), indicates that on most litters, enchytraeid worms tended to favour samples without *M. androsaceus*, but other fauna those samples with *M. androsaceus*. Eaten areas occurred on 85 and 66 % of individual bleached and unbleached leaves respectively within four Rubus samplings.

4.2. Relationship of *M. androsaceus* and fauna to weight loss of decomposing litters

The occurrence of *M. androsaceus* and fauna were examined in relation to the weight loss of individual samples of the longterm decomposition experiment. Within some sample sets slightly higher weight losses were recorded for samples with *M. androsaceus*, and weight loss and colonization by the fungus were correlated among Rubus samples, at 3 months and 1 year ($r = 0.694^*$, 0.640^*) and Calluna stems at 3 years ($r = 0.897^{***}$).

The mean weight loss of Rubus samples invaded by enchytraeids was about 17 % higher than that of samples with no worms ($F = 4.0^*$). Samples were then separated into four classes according to presence or absence of both *M. androsaceus* and enchytraeids and the dry weight losses for each class at each sampling time of Rubus leaves are graphed in Fig. 1. These comparisons are of limited value for a number of reasons. The samples contained both colonized and uncolonized parts and the number of samples within each group was low, with different samples being examined at each sampling time, making it impossible to follow the course of decomposition for individual leaves or samples. Older samples on which *M. androsaceus* was not apparent, may have been colonized at an earlier stage, since bleached leaves probably darken and show no signs of attack at later stages.

No firm conclusions are therefore possible, but there were indications that samples with both *M. androsaceus* and enchytraeids had the highest losses and towards the end of the experiment, samples with *M. androsaceus* but without enchytraeids had a decreased rate of loss while samples without *M. androsaceus* had a relatively high loss.

Moisture content was negatively correlated with the occurrence of *M. androsaceus*, significant for Eriophorum samples at 3 and 5 years ($r = -0.710^*$, -0.775^*)[1]). The mean moisture content of Eriophorum samples with *M. androsaceus* was 391% compared to 636% for samples without the fungus, significant at $p < 0.025$. On Calluna shoots the moisture contents were lower, 262% compared to 315%, and the difference between them was not significant ($p > 0.250$). On the other hand, enchytraeids and diptera were more often present on samples with higher moisture contents, of about 3—500 % (Table 3), indicating that litter with *M. androsaceus* may sometimes have too low a moisture content for optimum feeding by such fauna.

4.3. Dry weight loss of bleached and unbleached R. chamaemorus leaves

This experiment compared the weight loss of samples containing sorted 8 month old litter after decomposition in the field for one year. Bleached leaves of *R. chamaemorus* showed a significantly higher ($p < 0.001$) weight loss compared with leaves which were not bleached at the beginning of the experiment (Table 4). On retrieval, half of the originally unbleached leaves were seen to be colonized by *M. androsaceus* (Table 4 B) showing that even though some leaves became colonized others still remained uncolonized after two years. The majority of the retrieved leaves showed loss of lamina through fauna feeding, and this was most extensive on the bleached leaves. No enchytraeid worms were seen on either set of samples (Table 4 B) but enchytraeid populations at Moor House are low during spring and summer (STANDEN 1973), and the mean moisture contents of 122 and 138% for the bleached and unbleached leaves at retrieval were well below the optimum of 200—370 % for *C. sphagne-*

1) significant at $p < 0.05$ (*), significant at $p < 0.001$ (***).

Table 3. Moisture content of litter decomposition samples with presence or absence of fauna, for period when fauna type was present

A. Enchytraeidae	Rubus leaves	Eriophorum leaves	Calluna shoots
Present	402 ± 47	484 ± 49	323 ± 29
Absent	260 ± 81	310 ± 42	246 ± 25
F =	2.1	5.8	3.9
P <	0.250	0.025	0.10
Sample ages	2 years	1—4 years	1—4 years
B. Diptera			
Present	366 ± 19	561 ± 62	295 ± 14
Absent	208 ± 34	356 ± 38	291 ± 14
F =	17.3	4.3	4.1
P <	0.001	0.05	0.10
Sample ages	1—4 years	1—3 years	2 years

Table 4. One year, litter decomposition experiment with initially bleached and unbleached, 8 month old leaves of *R. chamaemorus*

A. Dry weight loss and moisture content, mean values ± S E, n = 10

	Unbleached	Bleached	F ratio	P <
Initial weight of samples in g.	0.62 ± 0.04	0.65 ± 0.02	< 1.0	
Dry weight loss as % of initial weight	*34.76 ± 2.03*	*57.21 ± 1.89*	65.5	0.001
Moisture content as % odw	*122.2 ± 27.0*	*138.0 ± 29.2*	< 1.0	

B. The occurrence of *M. androsaceus* and fauna on the ten samples

	Unbleached	Bleached
M. androsaceus rhizomorphs	4	9
bleached	1	10
Enchytraeids	0	0
Other fauna, mean no. per sample	1.4	1.9
Eaten, max. score = 20	11	20

Table 5. Laboratory feeding tests with enchytraeid worm on leaf litters of *R. chamaemorus*

A. Growth and survival of *C. sphagnetorum*. Growth is expressed as segment increase per worm in 60 days, mean values ± S E, n = 20

	9 month litter		2—3 year litter
	Unbleached	Bleached	Unsorted
Growth	2.18 ± 0.51	24.13 ± 1.50	21.01 ± 2.30
No. of dead worms	7	1	1

B. Chemical analysis and *p*H of litters. Chemical contents are given as % dry weight of a singles sample

	9 month litter		2—3 year litter
	Unbleached	Bleached	Unsorted
Carbon	48.8	50.3	50.7
Nitrogen	1.57	2.01	2.63
Soluble tannins	11.0	9.7	7.5
Crude fibre	12.7	13.8	13.9
*p*H	3.61	3.90	3.65

torum in raw humus reported by ABRAHAMSEN (1971), or those at which enchytraeids occurred on decomposing litters in the field, (Table 3A). However feeding may have taken place on these Rubus samples during the autumn before retrieval or when the moisture content was higher. The total numbers of other fauna were slightly higher on the bleached than on the unbleached samples.

4.4. Growth of *C. sphagnetorum* on colonized leaves of *R. chamaemorus*

In this laboratory feeding experiment the segment increase of the enchytraeid worm *C. sphagnetorum* was compared on sorted, washed litters. Growth on bleached Rubus leaves as well as on older 2—3 year Rubus litter, was good, and was comparable to that on other litters and which gave the best worm growth among a number of tested foods (LATTER and HOWSON 1978). In contrast, worms grew very little on the unbleached leaves, some died (Table 5A) and the condition of all worms which remained alive was unhealthy.

4.5. Chemical analyses

Samples of sorted litter as used for the enchytraeid feeding test were analysed for some properties likely to influence faunal feeding. The bleached Rubus leaves showed higher carbon and nitrogen contents, lower tannin and higher *p*H (Table 5B). HINTIKKA (1970) also reported a higher nitrogen content for humus bleached by *M. androsaceus* and other basidiomycetes, but he reported a reduced *p*H value.

5. Discussion and conclusions

M. androsaceus occurred on all the decomposing moorland litters following 3—6 months of decay in the field, and enchytraeids, collemboles, mites and diptera occurred at 6 months or more. With the peak in fauna numbers following after that for *M. androsaceus* a causal succession could be indicated, though the involvement of other micro-organisms in the initial decay process cannot be ruled out. There was also evidence that leaves with *M. androsaceus* were more eaten and had higher numbers of some fauna but not of enchytraeids. In culture, the enchytraeid worm *C. sphagnetorum*, one of the common litter fauna, fed and grew on bleached Rubus leaves, but not on uncolonized leaves and worms also grew well on Calluna litter inoculated with a basidiomycete fungus (LATTER and HOWSON 1978) even though pure cultures of the fungus were toxic to worms. Effects of the fungus which could influence faunal feeding include the higher nitrogen content of bleached leaves, increased carbohydrate release (FRANKLAND 1974), physical softening of the tissues, or removal of a toxic effect. The fact that fauna followed after the peak of *M. androsaceus* suggests that any association is not direct, and in the case of *C. sphagnetorum* direct contact may even be undesirable, if the toxic effect of some basidiomycete mycelium in culture (SPRINGETT and LATTER 1977) is a general phenomenon, and occurs in the field. The differing optimum moisture contents also act against a direct association.

The death of worms on unbleached Rubus leaves in culture was not investigated, but may result from toxic constituents which are present in all the leaves and are later decomposed by microorganisms. It is also conceivable that leaves which have become bleached, are those which are more favourable for invasion by both the fungus and the worms, due to the variability of some property of freshly fallen litter; some decomposing litter did remain uncolonized by *M. androsaceus* after 2 years in the field.

Various workers have noted a negative relationship between the occurrence or feeding of litter fauna and the tannin content of litters (KÜHNELT 1963; SATCHELL and LOWE 1967) and white-rot basidiomycete fungi are known to attack these types of compounds (FÅHRAEUS 1949; LEWIS and STARKEY 1969). Tannin content of Rubus litter is high, up to 27% at leaf-fall (HEAL et al. 1977) and was still high in both types of leaves used for the feeding tests, but it is likely that toxicity will be due to a particular component which would not be demonstrated by the total tannin analysis used. For example, HEATH and KING (1964) and ANDERSON (1973) obtained evidence that gallic and protocatechuic acids may be responsible for lowered palatability of litter to fauna.

Reasons for the high numbers of enchytraeids found on some unbleached litters in the field (Table 2) could be its more favourable moisture content, the more rapid leaching of toxic constituents under field conditions or the ability of other micro-organisms to modify the chemical composition of unbleached litter for fauna. Since the desirable effect of *M. androsaceus* appears to be a chemical change in the litter and if enchytraeid occurrence follows some time after *M. androsaceus* attack on any leaf, consistent relationships between them would not be expected within sample sets for a particular date. The good growth of worms on the older mixed litter, compared to that on the young unbleached litter (Table 5) suggests that the toxic effect of unbleached litter may be only a temporary phase.

The increased decomposition of bleached Rubus litter in the first year is probably a direct causal relationship with *M. androsaceus* though it could be argued that if certain leaves are more susceptible to attack it is these leaves which also decompose faster. The thin appearance of bleached leaves and the known decomposing activities of white rot-type fungi (LINDEBERG 1944; HURST and BURGES 1967) suggest that a direct effect is likely. Results also suggested that the increased dry weight loss caused by *M. androsaceus* may be later accentuated by increased feeding and disintegration by some fauna, in comparison to uncolonized litter. Some data (Fig. 1) indicated that the increased initial dry weight loss shown by bleached Rubus litter may not continue in subsequent years, in particular if fauna are absent. Uncolonized litter may well follow a different pathway (SAITO 1966) but the final weight loss could still be similar. However for increased nutrient circulation, the first year loss is the more important rate.

The distribution of *M. androsaceus* on litters, as is usual for similar fungi, was irregular in time and space. Though common at Moor House the species is frequently absent from other moorland or Calluna sites. MACDONALD (1949) observed that the fungus grew best in old heather and where accumulation of *Sphagnum* spp. kept the Calluna stems damp. He stated that it may be controlled by regular burning or improved drainage of sites. On our decomposing litter samples, those without the fungus had a higher mean moisture content, so that moisture contents above the optimum also appear detrimental. More information is needed on the conditions which determine the distribution of fungi like *M. androsaceus* and the initiation of bleaching activity, as well as on the interrelationships between occurrence of the fungus and fauna, or their combined effects on litter decomposition rates. The sensitivity of *C. sphagnetorum* to some mycelium but its apparent preference for bleached or older Rubus leaves could be among the reasons for dominance of the worm in the field on older partially decomposed litters, and the study indicates the complexity of associations between fauna and microflora.

After faunal feeding, litter will remain as small particles or faeces whose decomposition has not been studied and whether such disintegration by fauna contributes to any acceleration of true decomposition rates, as opposed to weight loss has been critically discussed by SATCHELL (1974).

Since three of the main vegetation types on the blanket bog, are colonized by *M. androsaceus* all these relationships need to be better understood. The results suggest that the fungus, combined or interrelated with faunal attack could be an important link in the decomposition pathway of moorland litters.

6. Summary · Zusammenfassung

The basidiomycete fungus, *Marasmius androsaceus* occurred on decomposing litters of three of the predominant plants which grow on blanket peat at a moorland reserve in N. England. The fungus caused bleaching of the tissues.

The occurrence of fauna followed after the colonization of litter by *M. androsaceus* in the field, suggesting a succession of microflora and fauna, rather than a direct association. The moisture contents of litter samples with presence or absence of the fungus or of some of the fauna indicated that optimum requirements for the two groups are different.

In a one-year field experiment, bleached Rubus chamaemorus litter decomposed more rapidly than litter uncolonized at the start, and in a laboratory feeding test the enchytraeid worm, *Cognettia sphagnetorum*, grew better on bleached Rubus litter than on uncolonized litter.

The fungus, combined or interrelated with faunal feeding, appears to have an influence on the decomposition pathway of moorland litters.

Abbau von Moorlandstreu durch den Basidiomyceten *Marasmius androsaceus* und Bodentiere

Der Basidiomycet *Marasmius androsaceus* trat bei der Zersetzung von Streu von drei vorherrschenden Pflanzen auf, die auf einem Deckenmoor in einem Moorreservat in Nordengland wachsen. Der Pilz verursachte eine Bleichung der Gewebe.

Der Tierbesatz folgte im Freiland auf die Kolonisierung mit *M. androsaceus*, was eher auf eine Sukzession von Mikroflora und Fauna hindeutet als auf eine direkte Assoziation. Der Feuchtigkeitsgehalt der Streuproben, mit oder ohne Pilz bzw. Fauna, deutet darauf hin, daß die optimalen Bedingungen für die zwei Gruppen unterschiedlich sind.

In einem einjährigen Feldexperiment zersetzte sich gebleichte Streu von *Rubus chamaemorus* schneller als anfangs nicht kolonisierte Streu, und in einem Labortest gedieh die Enchytraeide *Cognettia sphagnetorum* besser auf gebleichter Rubus-Streu als auf unkolonisierter Streu.

Der Pilz scheint, kombiniert oder in Wechselbeziehung mit Tierfraß, einen Einfluß auf den Zersetzungsverlauf von Moorlandstreu zu haben.

7. Acknowledgements

I would like to thank Dr. J. C. Frankland for comments on the text, and Mrs. G. Howson for technical assistance.

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